

GRAVITATIONAL FORCES

✦ Risk Assessment: Low

▢ Safety Considerations:
None

▢ Environmental
Considerations: None

Terminal Learning Objective

ACTION: Manage the effects of gravitational forces

CONDITION: While performing as an air crewmember

STANDARD: In accordance with FM 3-04.301 and Fundamentals of Aerospace Medicine

Gravitational Force Terminology

“G”

Is the measure of the magnitude of an accelerative force with respect to gravity

- ✦ Equal to 32.2 fps^2

- ▢ Till terminal velocity is reached

Acceleration

Rate of change of velocity with
respect to time

- ✦ Gravity is the most common
accelerative force

Deceleration

Reduction in the velocity of a moving body (Negative Acceleration)

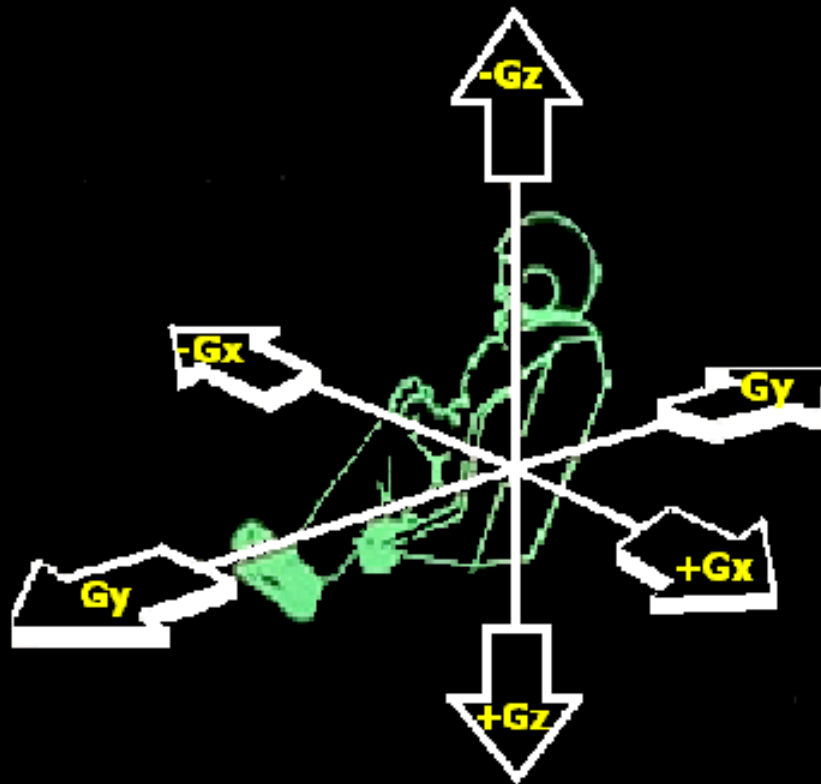
Inertial Force

- ✦ The resistance to change in the state of rest or motion

A body at rest tends to stay at rest, a body in motion tends to stay in motion, until acted on by an outside force

- ✦ Newton's third law of motion states for every action there is an equal and opposite reaction.

Tri-axial Reference System



Questions

Factors Affecting Accelerative Forces

- ▮ Intensity
- ▮ Duration
- ▮ Rate of onset
- ▮ Body area and site
- ▮ Impact direction

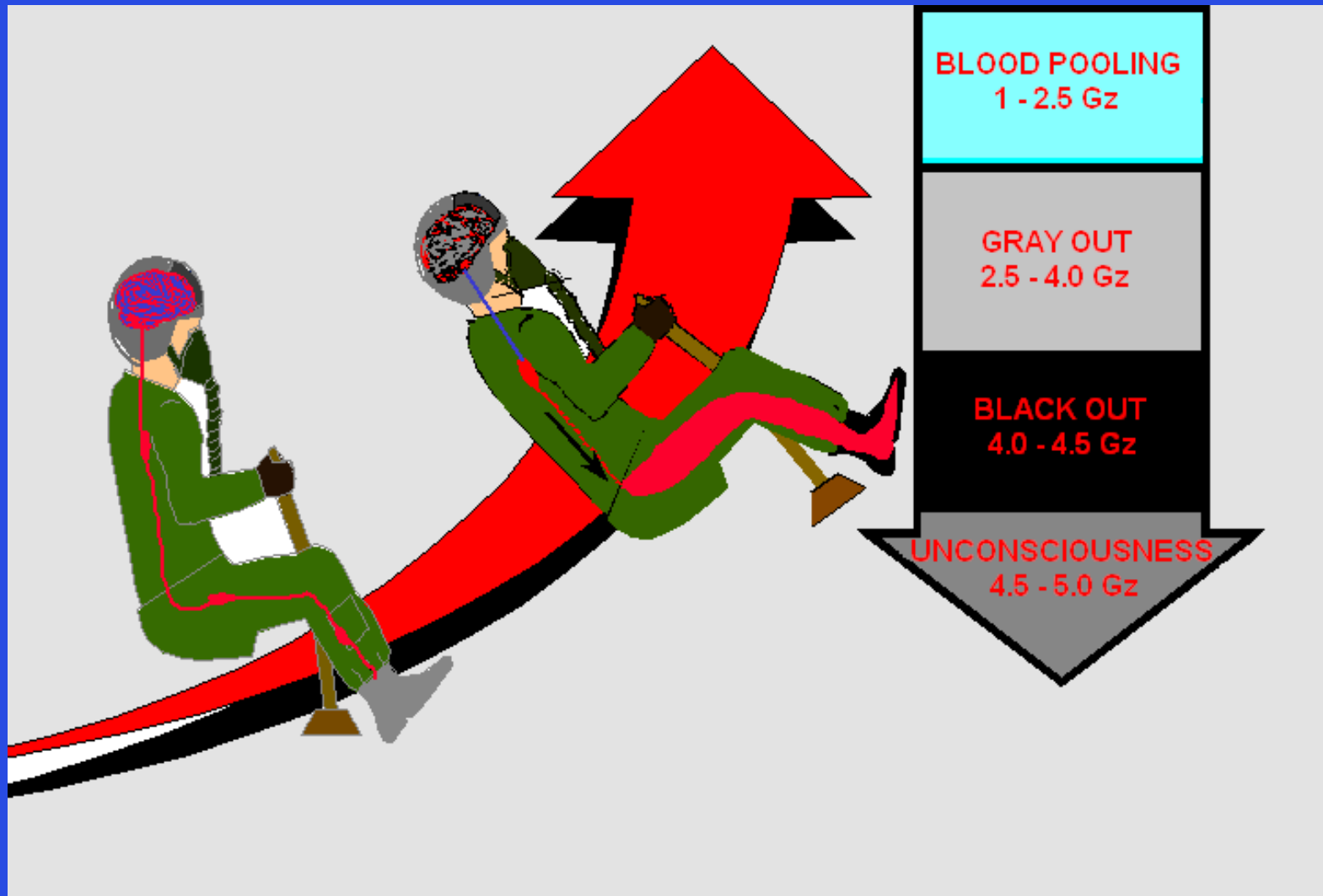
Questions

Physiological Effects of Low Magnitude Acceleration

Positive (+Gz)



Sustained Positive Acceleration (+Gz)



Factors Modifying (+Gz)

- ▮ Decremental Factors
- ▮ Incremental Factors

Decremental Factors

- ✦ Blood volume decrease
 - ▢ Blood pressure decrease
-
- dehydration
 - fatigue/illness
 - hemorrhage
 - acute alcohol abuse
 - varicose veins

Incremental Factors

- ✦ Asymptomatic Hypertension
 - ▢ Fear & excitement
 - ▢ Tensing of muscles
 - ▢ Short stocky build

L-1 Maneuver

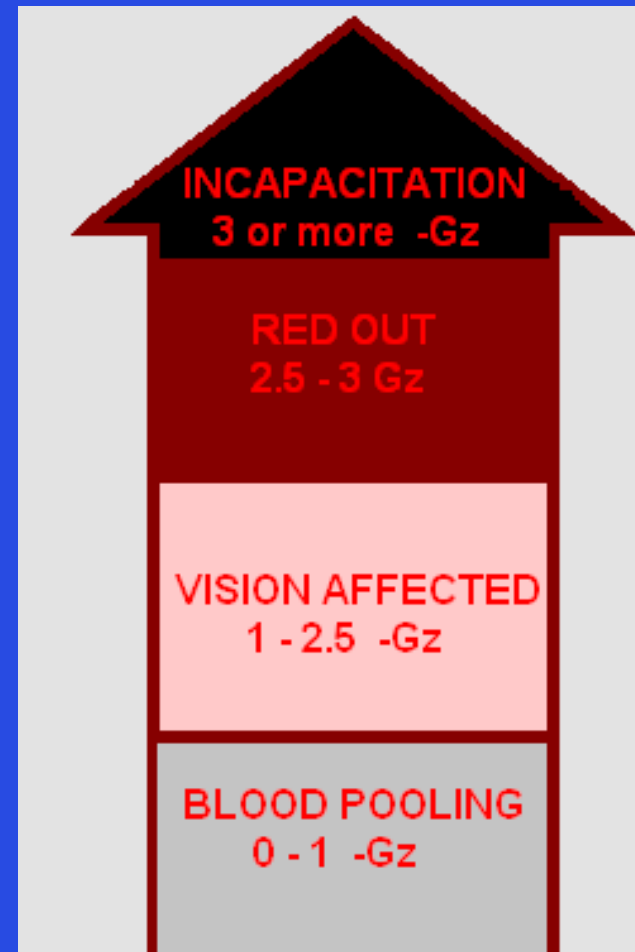
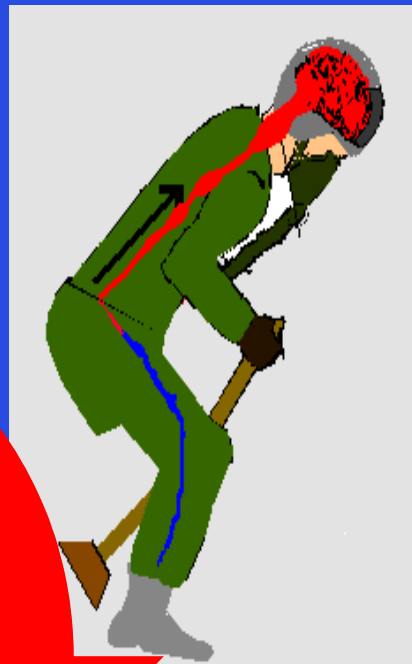
- ✦ Remain upright
- ▢ Tense muscles
(extremities/abdomen)
- ▢ Exhale against a closed glottis
for 2 to 3 second intervals

L-1 Maneuver

- Exhausting
- Increases G-load tolerance by 4 g
- G Suit increases tolerance by 1 g

Negative (-Gz)

Sustained Negative Acceleration (-Gz)



(+/-) Gx Forces

Mild transverse
accelerations/decelerations during
landing and taking off

Gy Forces

Human body has minimal tolerance to left or right accelerations

- ✦ Most aircraft do not tolerate accelerative forces in the lateral direction

Questions

Physiological Effects of High Magnitude Acceleration and Deceleration

Sources

- ▮ Aircraft crashes
- ▮ Ejection seats
- ▮ Parachutes

Effects

- ✦ Minor discomfort
- ▢ Minor injury
- ▢ Incapacitating
- ▢ Irreversible injury
- ▢ Lethal

Questions

Air Crewmember Survivability during the Crash Sequence

Crash Survivability Criteria

- ✦ Amount of decelerative (crash) force transmitted to the crewmember

Crash Survivability Criteria

- ▮ Amount of decelerative (crash) force transmitted to the crewmember
- ▮ Occupiable living space

Crash Survivability Criteria

- ▮ Amount of decelerative (crash) force transmitted to the crewmember
- ▮ Occupiable living space
- ▮ Aircraft design features (CREEP)

Aircraft Design Features “CREEP”

- ✦ Container
- ▢ Restraint System
- ✦ Environment
- ✦ Energy Absorption
- ✦ Postcrash Protection

QUESTIONS

Conclusion